INFORMAL LETTER PROGRESS REPORT TO NASA ON PROGRESS AT THE JICAMARCA RADAR OBSERVATORY DURING THE PERIOD JUNE - SEPTEMBER, 1965

NASA FUND TRANSFER R-83

OPERATIONS

1. Incoherent Scattering: During the period covered by this report, the main effort at Jicamarca has been devoted to improving the quality of the correlation function measurements, thus enabling us to obtain accurate measurements of the composition and temperature of the ionosphere up to altitudes of the order of 1000 km. Such measurements should go a long way towards helping to unravel some of the complexities of the behavior of the equatorial ionosphere. They provide far more information than measurements of the electron density alone. Previous attempts at explaining the equatorial anomaly, for instance, have had to assume temperature and composition models to go with known electron density distributions. Given an accurate, observed equatorial profile of all three quantities simultaneously, it should be fairly easy to produce a theoretical latitudinal distribution of electron density and compare this with, for example, topside sounder measurements.

The correlation function measurement has been explained in several previous reports. Pairs of pulses, separated by various time delays and having opposite circular polarizations, are transmitted. With a suitable receiving arrangement, one can then obtain

$$\rho(\Delta t) = \frac{\overline{V(t)\, V^*(t+\Delta t)}}{\overline{|V(t)|^2}}$$

for various values of Δt, the pulse separation.

Now in this operation it is essential that none or the parameters of the equipment vary with Δt; i.e., the power and phase of the transmitted pulses, the behavior of the TR switches, the gain of the receivers, etc. all must remain constant. The time delays are such that the pulses may be coincident ($\Delta t = 0$), may partially overlap, or may be entirely separate. The different delays can affect the drain on the transmitter power supply, the line voltage, the heating of the various spark gaps and protective devices for the receivers, etc.; any one of these may be

enough to upset the measurement. We have been attacking these problems one by one, and the goal now seems to be in sight. We have not made any major changes in the equipment or measuring technique, but a long series of minor adjustments, improvements, and modifications have resulted in a major improvement in the results.

During the period 17-19 August, 1965, we made a series of observations of the correlation function. Although some of the data was still of poor quality, more than half of it was acceptable, and some of it was excellent, showing essentially perfect agreement with the theoretical curves. We obtained several good profiles of temperature and composition, both during the day and at night. It seems that there are still a few intermittent difficulties which we have not yet solved, but hopefully these will be cleared up soon. The important thing is that we have established to our own satisfaction that it is possible to get really good results with this technique. It is admittedly much more difficult to do so than we had originally anticipated, but it is not impossible. The potential value of the results certainly justifies the rather large amount of time and effort required.

2. Synchrotron Radiation: At the request of the NASA Manned Space Flight Center in Houston, we maintained a continuous 24-hour watch for synchrotron radiation during the flight of Gemini V. A high altitude thermonuclear explosion might inject a sufficient number of high energy particles into trapped orbits in the earth's magnetic field to endanger the astronauts. In the event of such an explosion, we would observe a marked increase in the cosmic noise level, due to synchrotron radiation, within about five minutes or less of the time of the explosion. After the Starfish test in July, 1962, the noise level increased briefly by a factor of ten, but fortunately no increase was observed during the Gemini flight. During the course of these observations we also measured the residual synchrotron radiation level, most of which is probably due to particles injected during the Starfish test. The intensity of this radiation, in terms of noise temperature at 50 Mc/s, is now about $35^{\circ}K$, compared to the minimum cosmic noise background of about $5000^{\circ}K$. The sensitivity of the measurement is such that we may in the future be able to measure radiation from the natural

Van Allen belt particles.

DATA ANALYSIS

Some time has been devoted to developing automatic or semi-automatic methods of analyzing correlation function data. A quite sophisticated computer program has been developed by R. S. Lawrence and M. Hallenbeck in Boulder. The first attempts at using this program have given encouraging results. The one disadvantage is the problem of rapid and efficient data transfer between Jicamarca and Boulder. We are also working on methods that can make use of the smaller computer at Jicamarca.

Some preliminary work has been done towards determining, from our recent data, the rates of production and loss in the ionosphere. Comparison of our results with topside sounder results, both over Jicamarca and at nearby latitudes, is continuing.

OTHER

During the period 6-17 September, 1965, R. Cohen, D. T. Farley, and J. P. McClure attend the Second International Symposium on Equatorial Aeronomy in Sao Jose dos Campos, Brazil. They presented a total of twelve short papers on work at Jicamarca, as well as two review papers.